

The Roadmap to 80X2050

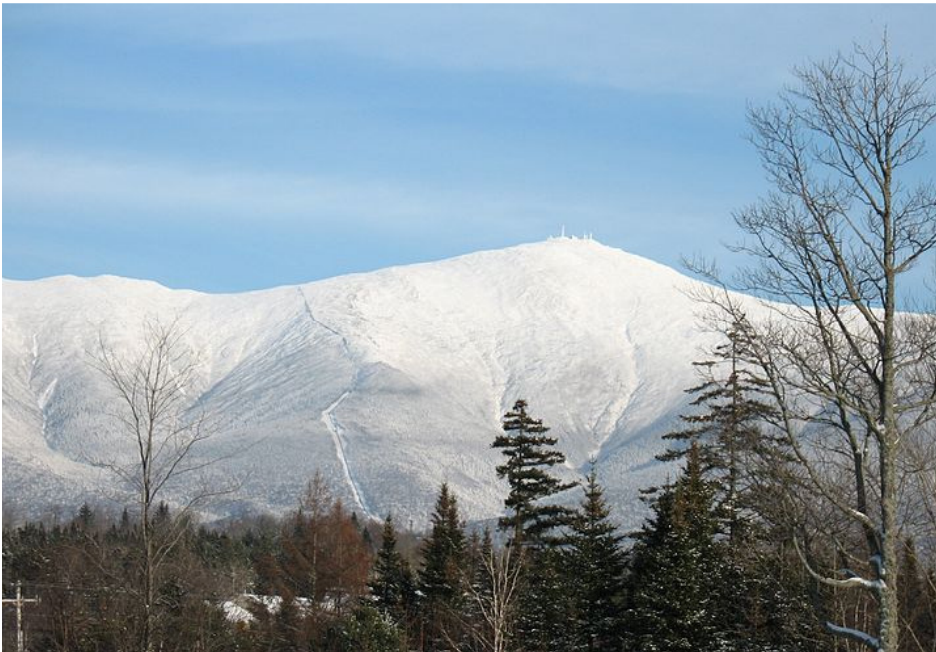
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Signposts on the “Low Carbon Highway”

- 1. The imperative for action is clear**
- 2. Capital markets are taking notice and starting to lead the change**
- 3. Common “roadmaps” to deep emissions reductions are emerging**
- 4. The King County regional approach is an opportunity for national leadership**

Exactly How Are We Going to Do This???

25% by 2020



6,200 feet

80% by 2050



29,000 feet

Innovation Network for Communities Background



***Scan of Leading Edge
Thinking and
Practice on Carbon-
Neutral Communities***
<http://carbonneutral.in4c.net>



Innovation Network
for Communities



***Carbon Neutral City
Network***

C40CITIES
Climate Leadership Group

USDN

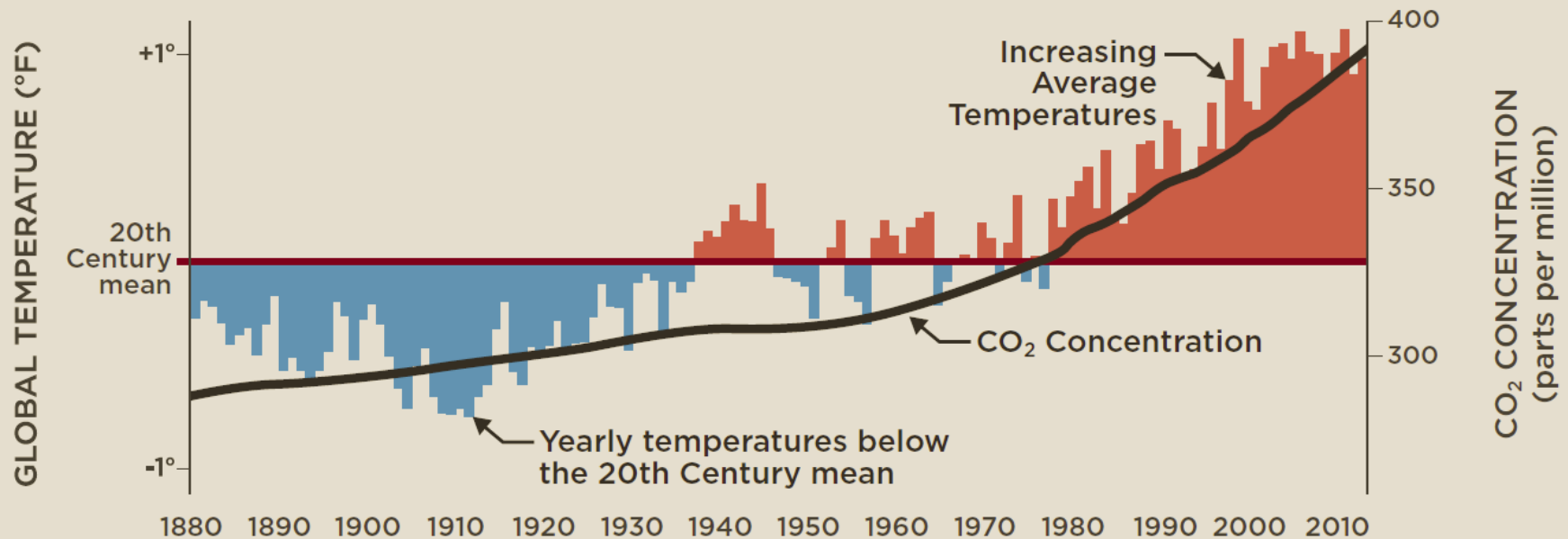
The Imperative for Action is Clear

The Long-Term Trends Are Clear



WHAT IS HAPPENING ON A GLOBAL SCALE?

TEMPERATURES AND ATMOSPHERIC CARBON DIOXIDE (CO₂) LEVELS ARE RISING.



The Effects Are Already Being Felt



WHAT RELATED IMPACTS ARE HAPPENING IN OUR REGION?

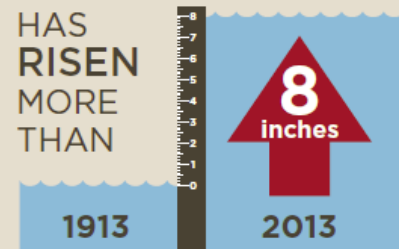
CLIMATE CHANGE IS AFFECTING OUR ENVIRONMENT, ECONOMY AND HUMAN HEALTH.

OCEANS

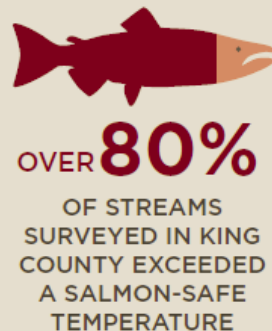
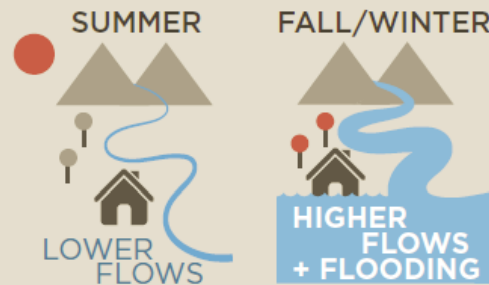
OCEAN WATER



PUGET SOUND



RIVERS

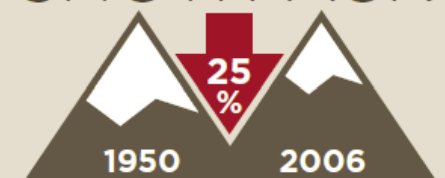


FLOODING HAS CLOSED



MOUNTAINS

AVERAGE CASCADE SNOWPACK



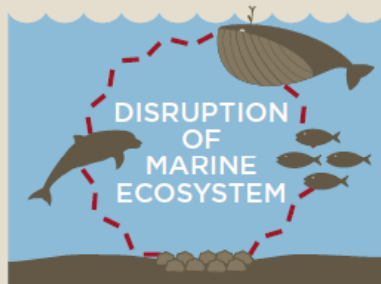
A Failure to Act Increases Future Risks



WHAT IS THE RISK FOR OUR REGION IN THE FUTURE?

IF WE DON'T ACT NOW, THE COSTS AND CONSEQUENCES WILL GROW.*

OCEANS



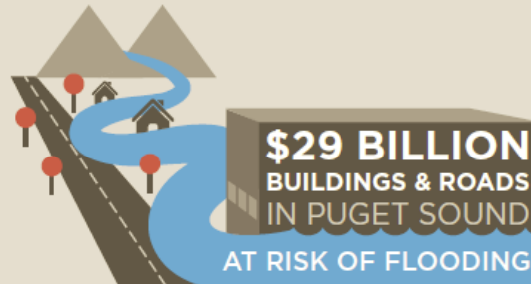
MARINE-BASED ECONOMIES



SUFFER AS

FISH/SHELLFISH DIMINISH

RIVERS & STORMS

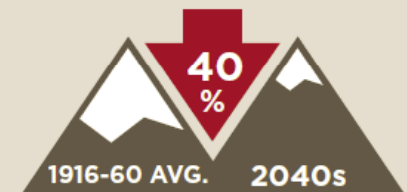


INCREASE IN SEVERE STORMS



MOUNTAINS

AVERAGE WASHINGTON SNOWPACK



PNW ACRES BURNED BY **WILDFIRES** EVERY YEAR



Global Capital Markets Are Waking Up to the Climate Challenge

Recent Headlines

“Industry Awakens to Threat of Climate Change”

(New York Times, 1.23.14)

“For Insurers, No Doubts On Climate Change”

(New York Times, 5.14.13)

“Major Pension Funds Ask for Climate Change Study”

(Associated Press, 10.24.13)

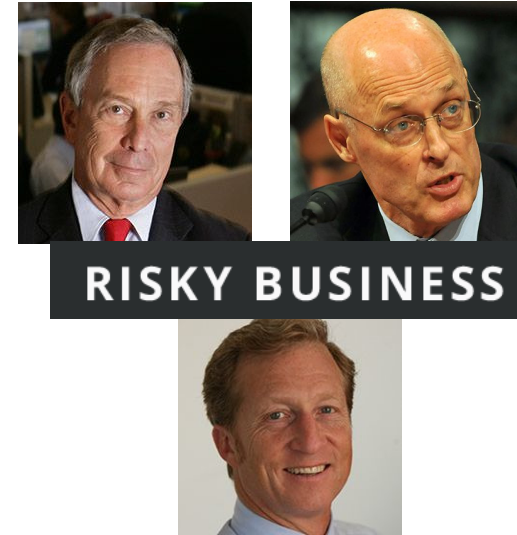
“No Climate Change Deniers to be Found in the Reinsurance Business”

(Globe and Mail, 11.28.13)

“Activist Investors Put Climate Change Issue Up For Vote At Bank”

(LA Times, 2.21.13)

Trends to Watch



Unburnable Carbon 2013:
Wasted capital and stranded assets

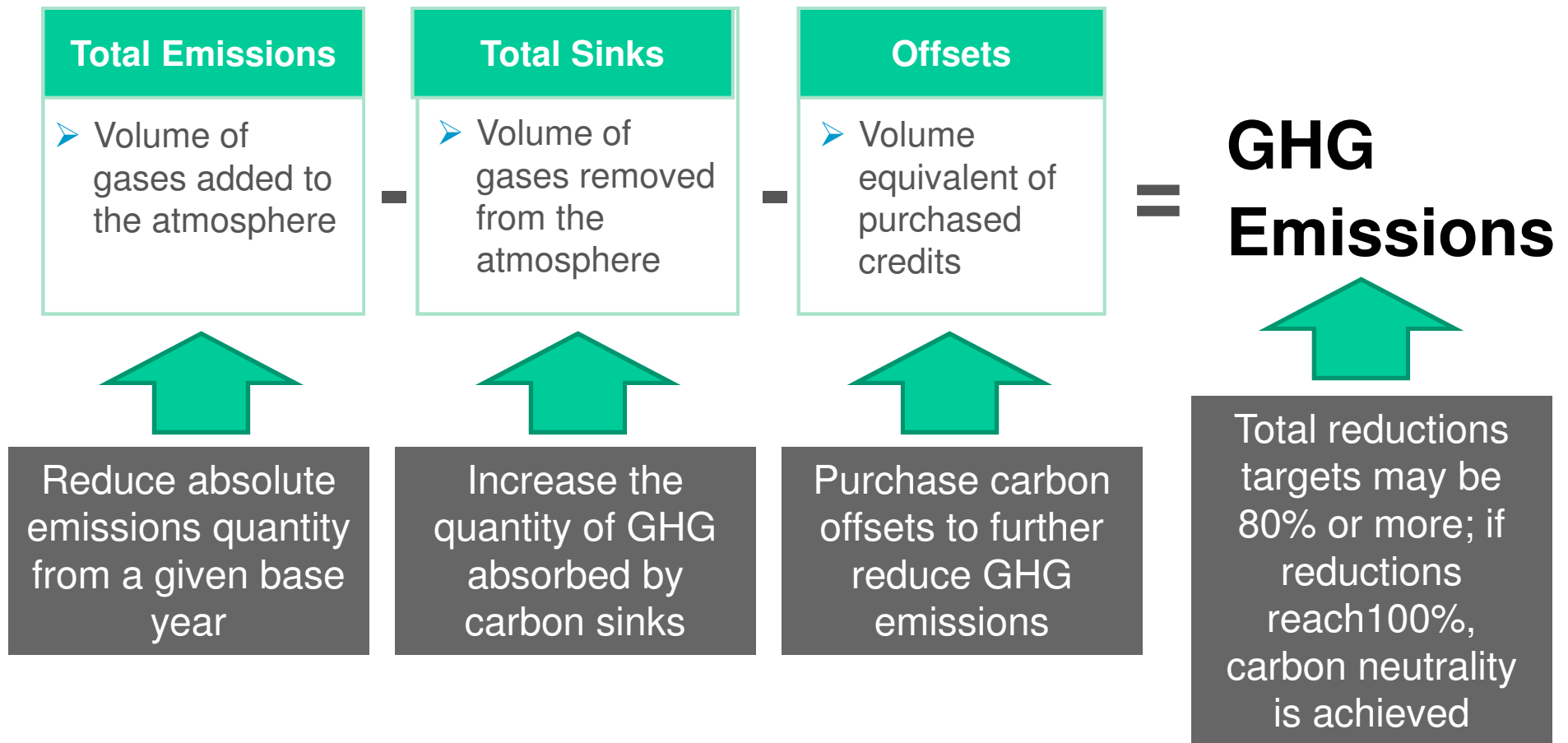


Emerging 80X50 Roadmaps

Roadmap Contents

- **Emissions reductions calculations**
- **Priority strategies**
- **Weaving of strategies into “roadmaps”**
- **Phased implementation, now to 2050**
- **Key Performance Indicators**

The Emissions Reductions Formula



Growth Factors Increase the Challenge

Projected Emissions
Decrease
(1990-2050)

80%

(average **-2.28%** decline
annually)

Projected Population Increase
(1990-2050)

76%

(average **.95%** growth
annually)

Projected GDP Increase
(1990-2050)

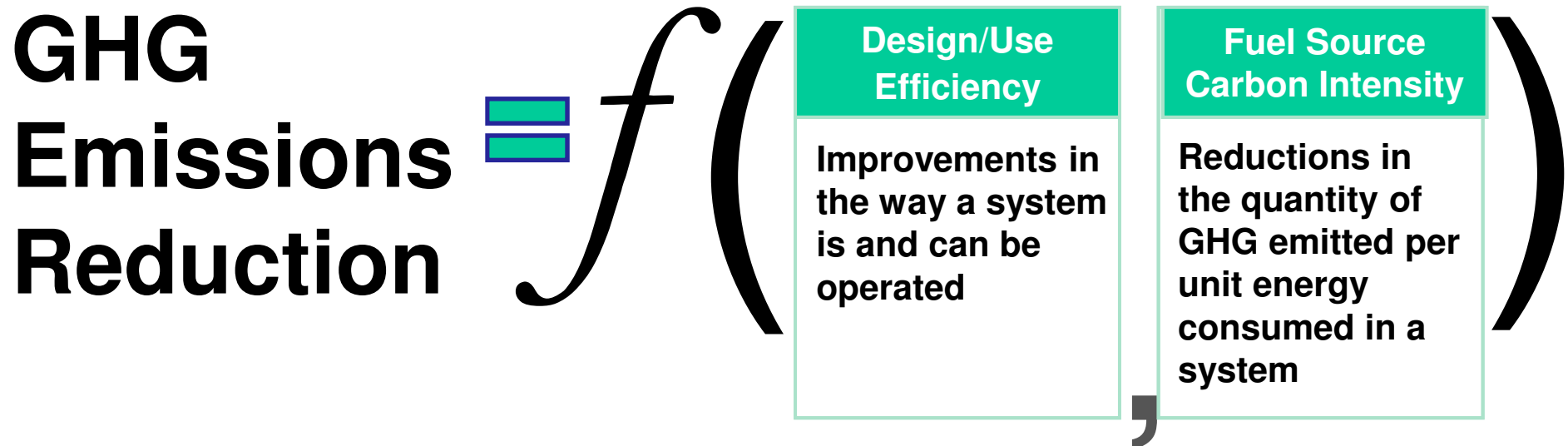
561%

(average **3.2%** growth
annually)

Taking growth projections into account, an 80% reduction in total emissions by 2050 implies:

- An **88%** reduction in per capita emissions
- A **97%** reduction in per unit of GDP emissions

Two Sides to the Equation



Strategy Requires Choices in the Blend

Illustrative Reductions

$$\begin{aligned}
 \text{GHG Emissions Reduction} &= f \left(\text{Design/Use}, \text{Fuel Carbon Intensity} \right) \\
 &= f \left(\begin{array}{l} \text{0\% change in} \\ \text{design/use} \\ \text{efficiency} \end{array}, \begin{array}{l} \text{100\% de-} \\ \text{carbonization of} \\ \text{power/} \\ \text{transportation/} \\ \text{industrial fuel} \\ \text{systems} \end{array} \right) \\
 80\% &= f \left(\begin{array}{l} \text{50\% gains in} \\ \text{design//use} \\ \text{efficiency} \end{array}, \begin{array}{l} \text{60\% de-} \\ \text{carbonization of} \\ \text{power/} \\ \text{transportation/} \\ \text{industrial fuel} \\ \text{systems} \end{array} \right) \\
 &= f \left(\begin{array}{l} \text{70\% gains in} \\ \text{design/use} \\ \text{efficiency} \end{array}, \begin{array}{l} \text{40\% de-} \\ \text{carbonization of} \\ \text{power/} \\ \text{transportation/in} \\ \text{dustrial fuel} \\ \text{systems} \end{array} \right)
 \end{aligned}$$

The Problem of Emissions “Scope”

- Scope definition varies from city to city
- Measurement and verification process varies city to city
- Sources of “emissions leakage” in city scopes:
 - Traded goods sectors
 - Industrial processes
 - Agriculture
 - Air travel
 - Consumption-based GHGs
 - Cities without strategies

Different Emphasis From Different Experts



VS.



VS.



Federal / State

- **Emphasis:** national/regional strategies
- **Targets:** institutions such as Congress, Public Utility Commissions, Federal agencies (DoE, EPA)

City

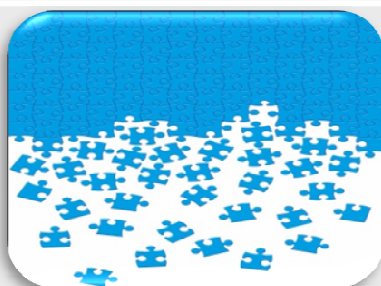
- **Emphasis:** city controlled levers such as building codes and land use policy
- **Targets:** mayors and city council members, transit authorities

District

- **Emphasis:** local/neighborhood level action
- **Targets:** communities, large institutions, and local land/building owners/influencers



VS.



Prioritizers

- **Emphasis:** the importance of targeting high emitting sectors
- **Targets:** electricity generation, new building construction

Anything & Everything

- **Emphasis:** The importance of addressing a range of emitting sectors and strategies
- **Targets:** range from waste/recycling to industrial processes



VS.



Incrementalists

- **Emphasis:** evolutionary improvements to existing GHG mitigation concepts and technologies
- **Targets:** energy efficiency, existing technology

Revolutionaries

- **Emphasis:** revolutionary advances and innovations in GHG mitigation concepts and technologies
- **Targets:** speculative generation technologies, systemic cultural/political change

Sources: OHcp/INC analysis.

Nine Key Strategies in Six Sectors

Emissions Source	Carbon Reduction Strategy	Design/ Use	Fuel Intensity
<i>Commercial & Residential Buildings</i>	Achieve net zero emissions in 100% of new buildings by 2030	✓	✓
	Achieve 30%-50% emissions reductions in 100% of existing buildings	✓	
<i>Industrial</i>	Achieve 3%+ annual improvements in energy efficiency of industrial processes, and reduce building energy use by at least 15%	✓	
<i>Transportation</i>	Achieve annual net decreases in total Vehicle Miles Traveled (VMT)	✓	
	Decrease emissions per VMT by 50%-75%		✓
<i>Waste</i>	Eliminate 100% of solid waste disposed of via landfill or incinerator	✓	
<i>Energy Generation</i>	Achieve 80%-90% de-carbonization of the electricity and heating supply		✓
<i>System-Wide</i>	Implement efficient land use planning	✓	
	Design municipal infrastructure for low carbon performance	✓	

Typical Initiatives and Level of Control (1)

Sector	Strategy	Initiative	Level of Control
<i>Commercial & Residential Buildings</i>	Achieve net zero emissions in 100% of new buildings by 2030	Net Zero Building Codes	State
		Mandatory Building Benchmarking	Municipal
		Mandatory Building Commissioning	Municipal
		Geothermal Heat Pumps	Municipal
	Achieve 30%-50% emissions reductions in 100% of existing buildings	Mandatory building retro-commissioning	Municipal
		Required retrofitting upgrades at transaction	Municipal
		Reduce appliance/equipment energy demand by 30%	Municipal

Sector	Strategy	Initiative	Level of Control
<i>Industrial</i>	Achieve 3%+ annual improvements in energy efficiency of industrial processes, and reduce building energy use by at least 15%	Achieve 3%+ annual improvements in energy efficiency of industrial processes through equipment upgrades and process/product redesign	Federal
		Reduce building energy use by at least 15% through mandatory retro-commissioning and mandatory retrofitting	Municipal

Typical Initiatives and Level of Control (2)

Sector	Strategy	Initiative	Level of Control
<i>Transportation</i>	Achieve annual net decreases in total Vehicle Miles Traveled (VMT)	Bike and pedestrian friendly streets	Municipal
		Bike sharing and car sharing	Municipal
		Increased access to transit	State
		Performance based tolling and parking fees	State
		Parking restrictions in high density areas	Municipal
		Employer based demand management	Municipal
		Transit oriented development	Municipal
	Decrease emissions per VMT by 50%-75%	Increased vehicle mileage standards	Federal
		Alternative low carbon fuels (EV, bio-fuels, hybrids, fuel cells)	Federal

Sector	Strategy	Initiative	Level of Control
<i>Waste</i>	Eliminate 100% of Solid Waste Disposed of via Landfill or Incinerator	Mandatory consumer and commercial recycling	Municipal
		Single or no-stream recycling (100% of all waste)	Municipal
		Construction/demolition recycling and reuse	Municipal
		Organics Composting and waste-to-energy	Municipal

Typical Initiatives and Level of Control (3)

Sector	Strategy	Initiative	Level of Control
<i>Energy Generation</i>	Achieve 80%-90% de-carbonization of the electricity and heating supply	Replace 100% of coal fired electricity generation with natural gas or renewables	State/Federal
		Implement on-site energy generation in 100% of eligible structures	State
		Develop district energy/heating/cooling in 100% of eligible densely built areas	Municipal
		Implement 50%+ renewable portfolio standards	State
		Implement shared renewable power purchasing programs	Municipal
		Implement carbon capture and sequestration	Federal

Sector	Strategy	Initiative	Level of Control
<i>System Wide</i>	Implement Efficient Land Use Planning	Increase residential density through urban growth boundaries and promotion of infill development	Municipal
		Ensure that at least 6+ acres of green space are available per 1000 residents	Municipal
	Design Municipal Infrastructure for Low Carbon Performance	Deploy smart grids across 100% of municipality	Municipal
		Deploy high efficiency transmission lines across 100% of municipality	State
		Use smart infrastructure for 100% of city needs	Municipal
		Use green infrastructure to reduce the need for gray infrastructure	Municipal
		Implement tree planting programs	Municipal

Weaving Strategies into Multi-Decade “Roadmaps”

	Buildings	Industry	Transportation	Waste	Electricity	System Wide
Phase I Immediate (1-2 yrs)	Provide information and technical assistance	Drastically reduce GHG emissions from industrial processes and facilities	Plan for the future and encourage sustainable transportation choices	Provide education on the importance of waste diversion, and expanded access to waste diversion programs.	Develop plans for a renewable electricity infrastructure	Develop comprehensive long term land use/infrastructure plans that emphasize sustainability
Phase II Near Term (3-8 yrs)	Provide financial incentives for change while phasing in new standards for performance		Begin expanding sustainable public transit options, and increase the cost of high emissions transit options through approaches such as congestion pricing	Incentivize and ease private activity in the waste diversion sector.	Encourage the use of renewable power, and on-site renewable generation	Begin implementing transit oriented development plans, adjusted zoning regulations, and open space requirements
Phase III Medium Term (9-20 yrs)	Phase in emissions mandates/requirements for new construction and large existing buildings.		Invest heavily in efficient public transportation and infrastructure for pedestrians and bikers	Build capacity to divert waste produced by individuals, construction projects, businesses, industry, and multi-family housing.	Expand clean energy use, and phase out fossil fuel based electricity	Incentivize/regulate efficient land development, and continuously update long term plans
Phase IV Long Term (20-40 yrs)	Fully implement building codes that require carbon neutrality for new buildings, and mandate specific performance levels for existing buildings		Complete the build-out of a zero emission urban transportation system	Incentivize waste diversion financially through "pay as you throw" or similar programs.	Achieve carbon neutrality in the electricity sector	Continuously update and renew long term plans that encourage density, public transit, and walkable communities

BUILDINGS ROADMAP EXAMPLE

Buildings Roadmap Summary

Key Measures	Immediate (1-2 years)	Near Term (3-10 years)	Mid Term (10-20 years)	Long Term (20-40 years)
	Provide information and technical assistance	Provide financial incentives for change while phasing in new standards for performance	Phase in emissions mandates/requirements for new construction and large existing buildings	Fully implement building codes that require carbon neutrality for new buildings, and mandate specific performance levels for existing buildings
Efficient Operations	<ul style="list-style-type: none"> Audits, benchmarks, and disclosure Home energy audits and ratings Standards development Partnership development 	<ul style="list-style-type: none"> Technical assistance for retrofits Tax exemptions for retrofitted properties Voluntary retro-commissioning program 	<ul style="list-style-type: none"> Multifamily/commercial building performance standards Point of sale home energy upgrade requirements 	<ul style="list-style-type: none"> Existing building performance mandates
Efficient Construction	<ul style="list-style-type: none"> Low energy building development incentives Simplified green construction review and regulation Performance standards development 	<ul style="list-style-type: none"> EE standards for new construction Energy monitoring interfaces for tenants Density bonuses for new development Dense development 	<ul style="list-style-type: none"> Carbon neutrality mandates/requirements 	<ul style="list-style-type: none"> New construction efficiency mandates
Pricing and Financing		<ul style="list-style-type: none"> Green financing expansion Utility incentives for energy savings Retrofit/local generation incentives 		
Infrastructure for Low Carbon Fuels			<ul style="list-style-type: none"> District energy Fugitive/waste emissions/heat capture 	

Illustrative Buildings Roadmaps Metrics

Performance Metrics	Immediate (1-2 years)	Near Term (3-10 years)	Mid Term (10-20 years)	Long Term (20-40 years)
	Provide information and technical assistance	Provide financial incentives for change while phasing in new standards for performance	Phase in emissions mandates/requirements for new construction and large existing buildings	Fully implement building codes that require carbon neutrality for new buildings, and mandate specific performance levels for existing buildings
Efficient Operations	<ul style="list-style-type: none"> Number of home energy audits conducted Standards market penetration Number of partnerships signed 	<ul style="list-style-type: none"> Number of retrofits completed Total energy saved from retrofits Number of buildings that have undergone retro-commissioning 	<ul style="list-style-type: none"> Number of commercial/multi-family buildings that meet performance standards Number of home energy performance upgrades at the point of sale 	<ul style="list-style-type: none"> Average energy used per existing building
Efficient Construction	<ul style="list-style-type: none"> Number of low energy buildings constructed Average speed of green construction permit approval Performance standards market penetration 	<ul style="list-style-type: none"> Number of new buildings constructed that meet code Number of homes with energy monitoring equipment Average density of new development 	<ul style="list-style-type: none"> Amount of new construction meeting carbon emissions mandates 	<ul style="list-style-type: none"> Average energy used per new structure
Pricing and Financing		<ul style="list-style-type: none"> Dollar value of green loans closed Dollar value of incentives for retrofits available 		
Infrastructure for Low Carbon Fuels			<ul style="list-style-type: none"> Amount of energy supplied by district energy systems Total energy lost to heat 	

All Strategy Needs to Be Locally Customized



- **Emissions Profile**
- **Climate/Geography**
- **Level of System Control**
- **Capacity**
- **Opportunities for Traction**

Can We Really Do This???

Keys to Successful Implementation

- **Know your systems (intimately)**
- **Make it part of mainstream economics**
 - Quantify risks; Quantify benefits
 - Get the business community engaged
 - Use policy to organize resources for action
- **Get system leaders to internalize climate goals**
- **Have a grand design, but drill down to the doable**
- **Get data that tells you how you are doing real time**
- **Use short-term success to build commitment to the long term**

Example: Boston Large C/I Building EE Strategy



Save Energy, Save Money
Thomas M. Menino, Mayor



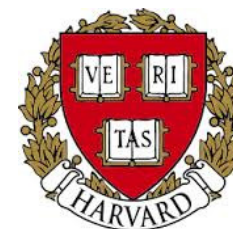
**Define emissions
targets**

**Define the
sectors**

**Develop sector
data**

**Identify key
accounts**

**Coordinate
account mgt**



The “Drill Down”

Total Boston Greenhouse Gas (GHG) Emissions (100%)



Commercial/Industrial Sources (50%)



Top 50 C/I Building Owners (30%)

Health Care

Higher Education

Commercial Real Estate

Government

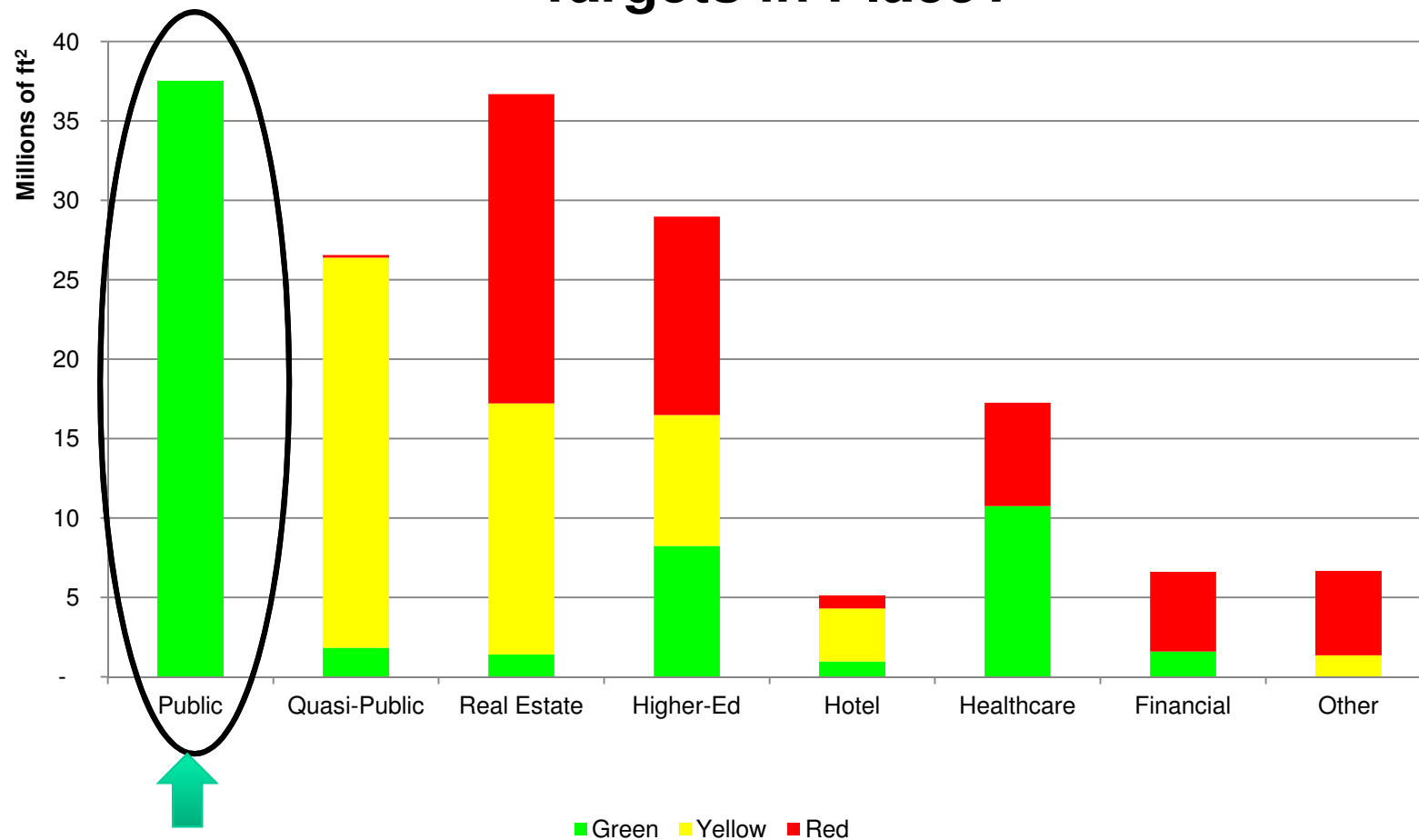
Hospitality, etc.

GOAL:

All top 50 owners are on target to exceed the City goal of 25% GHG emissions reductions by 2020.

Results By Sub Sector

Who in the “Top 50” Has 25% by 2020
Targets in Place?



**A Top
Opportunity**

The Public Sector Opportunity

Sector	Square Footage
City	36,844,449
State	20,639,454
Federal	6,611,336
Public Sector Subtotal*	64,095,239 (23%)
Other C&I	211,115,531
Total	275,210,770

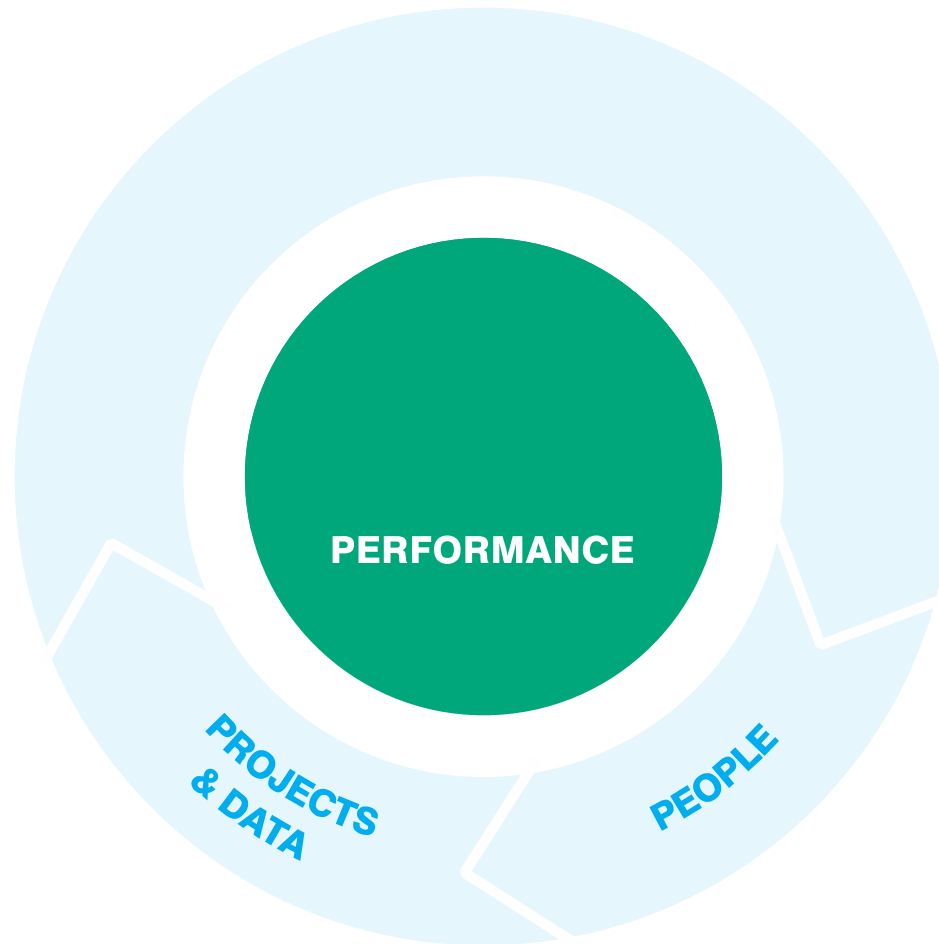
Owner by Owner

Boston Top 150 Database				Sector	Disclosure	Governance	Buildings	Targets	Programs
	Organization Name	Top 150 Cluster	Living Space Sq ft.						
1	City of Boston	Top 35	23,682,386	Public					
2	Boston Housing Authority	Top 35	11,336,704	Public					
3	Massport	Top 35	10,940,871	Public					
4	Commonwealth of Massachusetts	Top 35	8,409,886	Public					
5	United States of America	Top 35	5,445,327	Public					
6	Boston Public Health Commission	Top 35	1,825,359	Public					
7	USPS	Top 50	1,166,009	Public					
8	MBTA	Top 50	1,121,338	Public					

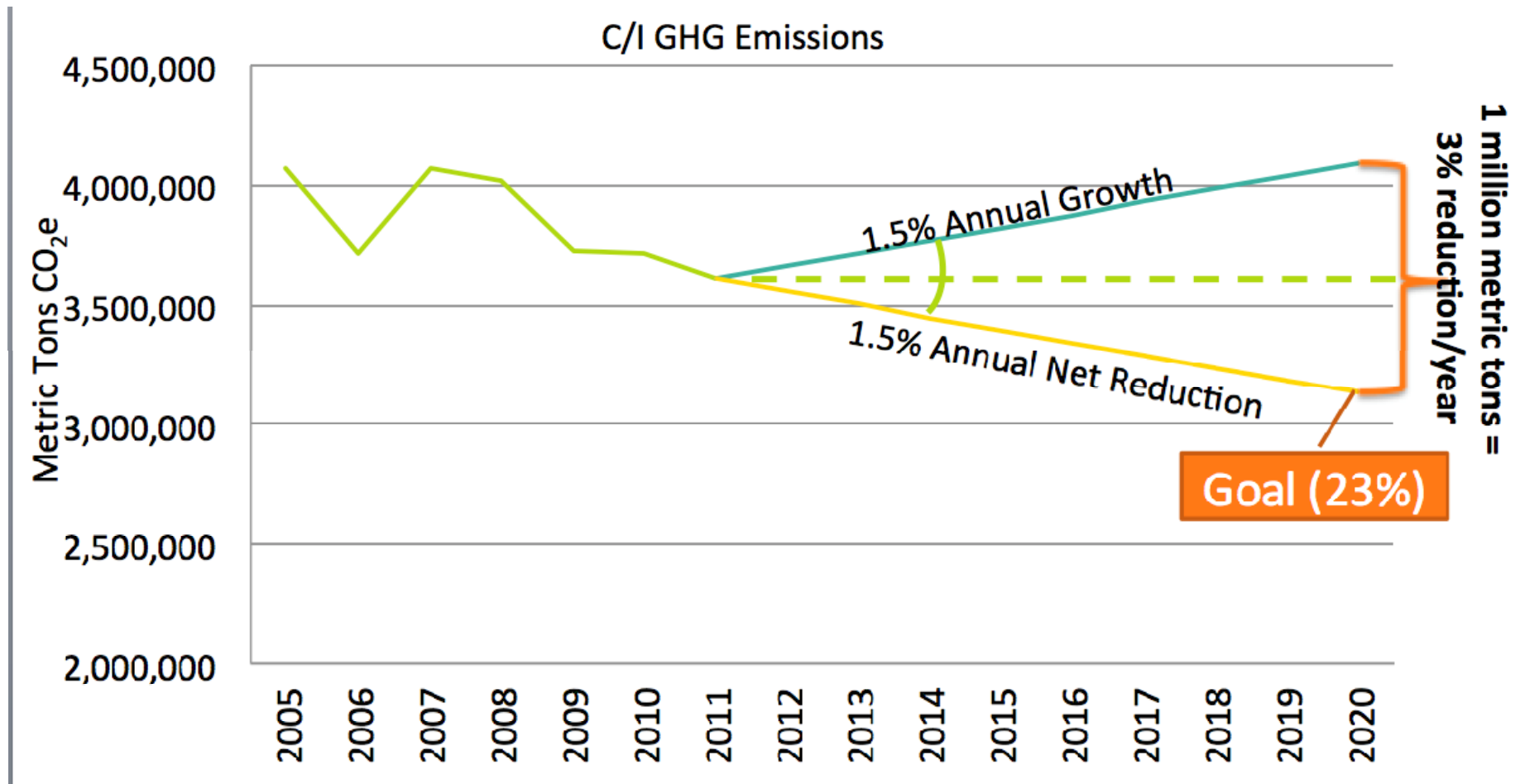
Building by Building

50	▼ United States of America	5,445,327
51	AMERICAN LEGION HW	35,334
52	MONUMENT SQ	21,794
53	MT VERNON ST	140,183
54	SIXTH ST	4,798
55	THIRD AV	40,800
56	MT VERNON ST	30,000
57	10 CAUSEWAY ST	669,964
58	115 CONSTITUTION RD	67,080
59	12 NORTHERN AV	938,400
60	13 15 WOODSIDE AV	3,724
61	15 17 STATE ST	39,780
62	15 55 NEW SUDBURY ST	788,776
63	20 STUART ST	198,970
64	25 27 LITCHFIELD ST	2,979
65	255 SPRING ST	486,051
66	408 ATLANTIC AV	131,446
67	409 423 COMMERCIAL ST	55,426
68	43 EVERGREEN ST	48,588
69	466 490 HANOVER ST	243,912
70	481 483 SUMMER ST	514,080
71	5 POST OFFICE SQ	699,694
72	93 CHELSEA ST	283,548

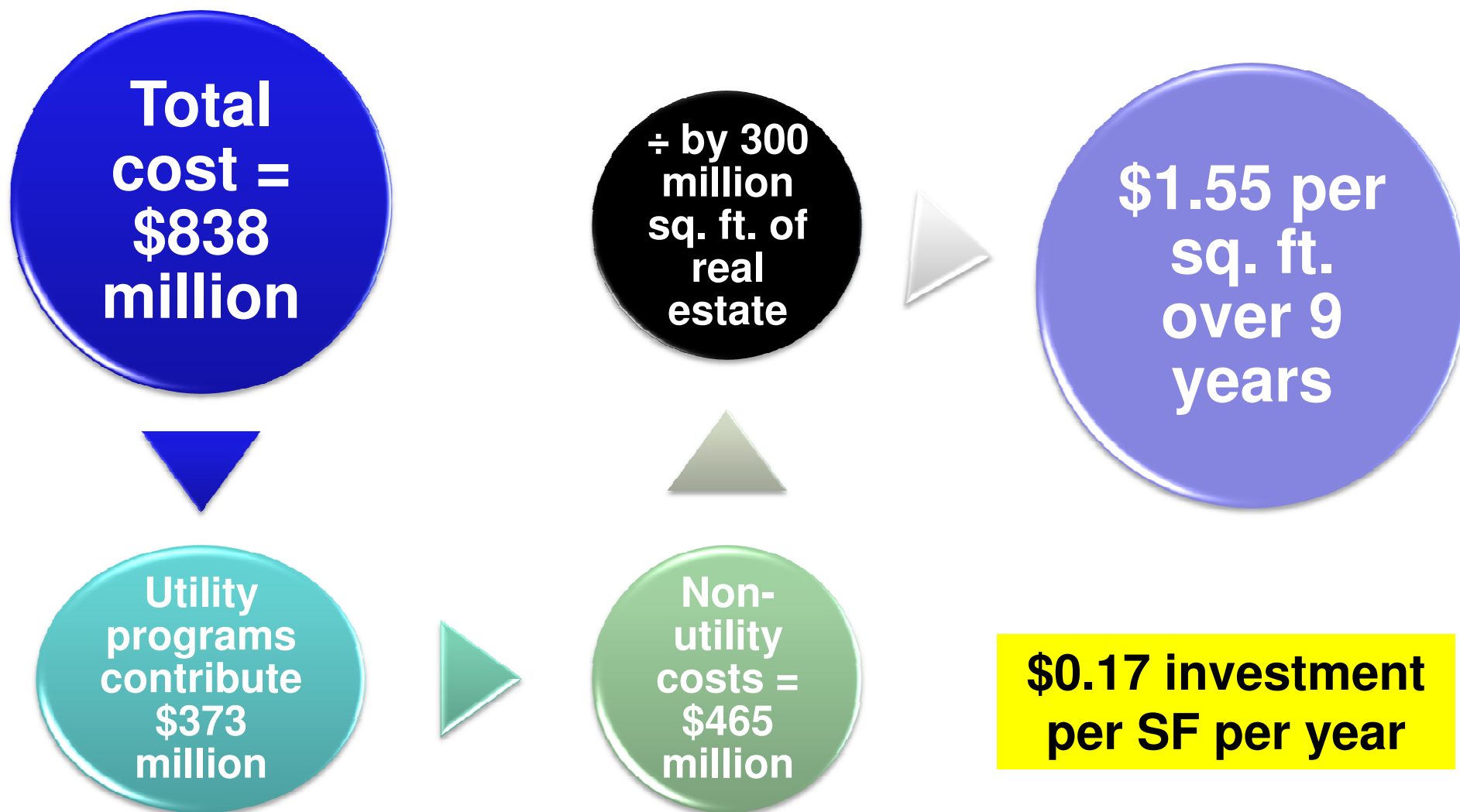
Strategic Energy Management Framework



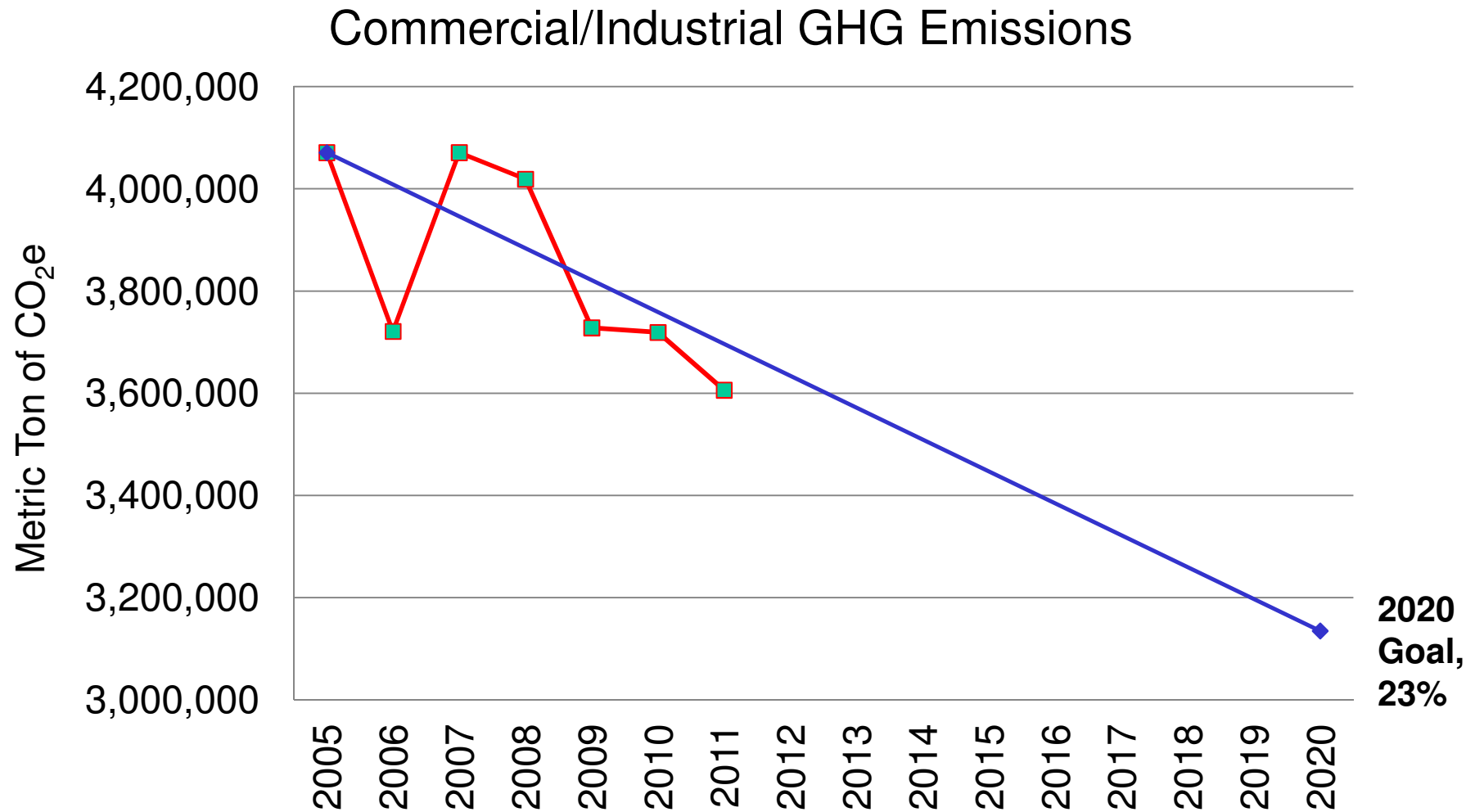
Carbon Reduction Target for 2020



How Much It Will Cost to Get There



So Far On Target



The Importance of Local Leadership & Innovation

Local Leadership Drives National Policy

- **The feds are not innovators...they are followers!**
- **Cities, states and regions are creating the climate action framework for the next generation**
 - ✓ California
 - ✓ Massachusetts, Connecticut
 - ✓ Northwest
 - ✓ Leader cities (NYC, Seattle, Portland, Vancouver, Boston, etc.)
- **Local innovation defines the “art of the possible” and builds political demand**

Requirements for Success

CATALYTIC LEADERSHIP

(Drives community towards planning & implementing solutions.)

PROVEN SOLUTIONS

(Creates technical feasibility to achieve outcomes.)

System	Solutions for GHG Reduction	Solutions for Preparedness	Solutions for Low Income Inclusion & Benefit
<i>Buildings</i>			
<i>Energy</i>			
<i>Transportation</i>			
<i>Waste & Water</i>			
<i>Land Use</i>			
<i>Other</i>			

PUBLIC WILL

(Gives leadership the political capital and courage to drive change.)

The “Collective Impact” Model

The Five Conditions of Collective Impact

Common Agenda	All participants have a shared vision for change including a common understanding of the problem and a joint approach to solving it through agreed upon actions.
Shared Measurement	Collecting data and measuring results consistently across all participants ensures efforts remain aligned and participants hold each other accountable.
Mutually Reinforcing Activities	Participant activities must be differentiated while still being coordinated through a mutually reinforcing plan of action.
Continuous Communication	Consistent and open communication is needed across the many players to build trust, assure mutual objectives, and create common motivation.
Backbone Support	Creating and managing collective impact requires a separate organization(s) with staff and a specific set of skills to serve as the backbone for the entire initiative and coordinate participating organizations and agencies.

(Source: “Embracing Emergence – How Collective Impact Addresses Complexity”, John Kania and Matt Kramer, Stanford Social Innovation Review, 2013)